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Musculoskeletal interventional ultrasonography: The upper limb

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Abstract Forty percent of the 823 ultrasound-guided injections performed in our centre over a year and a half concerned the upper limb, injections involving the shoulder, for subacromial bursitis and the treatment of calcific tendinitis, being the prime indications (24%). The wrist represented 8% of the prescriptions, for treatment of tendinopathy, ganglion cysts, carpal tunnel syndrome and rhizarthrosis. Trigger finger, tenosynovitis and pulley ganglia made up 6% of the indications and the elbow 2.5%. Ultrasound improves the accuracy of the procedure by helping guide the path of the needle and allowing the distribution of the substance injected to be visualised. We shall give details of the technique used for each indication, with advice and hints and post-procedure recommendations.

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The basic aim of musculoskeletal interventional ultrasonography is the injection of a therapeutic substance, usually a corticosteroid but in rare cases a visco supplement, into a specific site, a joint, tendon sheath, peritenon, retinaculum, serous bursa or an area of compression of a peripheral nerve. Other procedures include needle puncture-lavage of apatite calcification, needle evacuation of a collection (haematoma), ablation of a foreign body and, less frequently, a diagnostic biopsy.

Forty percent of the 823 ultrasound-guided procedures undertaken in our establishment over 19 months involved the upper limb, and all required injection. The shoulder area, with 24% ($n = 198$) of procedures, is the main upper limb site and second only to the hip. The majority of shoulder injections involve the subacromial bursa (79%), followed by treatment of calcific tendinitis (13%), the acromioclavicular and sternoclavicular joints (6%) and the

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sheath of the tendon of the long head of the biceps (2%). The wrist accounts for 8% of ultrasound-guided procedures and includes injection of tendon conditions (59%), with a majority of de Quervains tenosynovitis, followed by treatment of rhizarthrosis (28%), carpal tunnel syndrome (8%) and ganglion cysts (5%). The fingers account for 6% ($n=51$) of the sites injected. Trigger finger is the indication in 75% of cases, tenosynovitis in 8%, pulley ganglion in 10% and a joint is involved in 8% of cases. Finally, the elbow represents 2.5% ($n=20$) of the sites injected, in 60% of cases involving a tendon, in 30% for compression of the ulnar nerve and in 10% for bursitis.

In each of these indications, the role of ultrasonography is to select the pathological structure to be injected, accurately target the area to inject, in order, in particular, to avoid intratendinous injection, injecting rather at the periphery and in contact, and in order to actually inject into a bursa or cyst cavity to avoid damaging adjacent vessels and nerves. This implies continuously checking the path of the needle during the procedure and monitoring the distribution of the product during injection.

The fingers

Trigger finger

Trigger finger is stenosing tenosynovitis of the flexor tendons of the fingers related to thickening of the A1 pulley overlying the metacarpophalangeal joint (Fig. 1) [1]. It occurs most frequently in the thumb and fourth finger [2]. Several studies have confirmed the usefulness of guiding injections for this condition using ultrasonography. The injection is actually into the sheath in 70% of cases when the procedure is ultrasound-guided, but only in 15% when it is performed blind. There has been no intratendinous injection when using ultrasound guidance but this has occurred in 30% of cases without it. At 1 year, ultrasound-guided

injection gave good results in 90% of cases, with disappearance of the symptom after a single injection [3], versus 44% for blind injection [4]. Two injections should be offered to the patient before envisaging the possibility of surgical treatment.

Technique

All finger injections require the patient to be made comfortable with his or her arm relaxed with the hand flat on a table. A small "pencil" or "golf club" probe and a very fine needle (orange) are recommended (Fig. 2). Hydrocortancyl® or Altim® may be used.

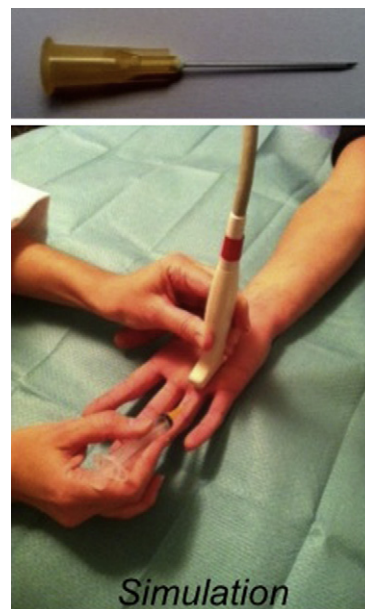


Figure 2. Simulation of the position of the patient for finger injections. A very fine needle (orange) and a pencil probe are recommended.

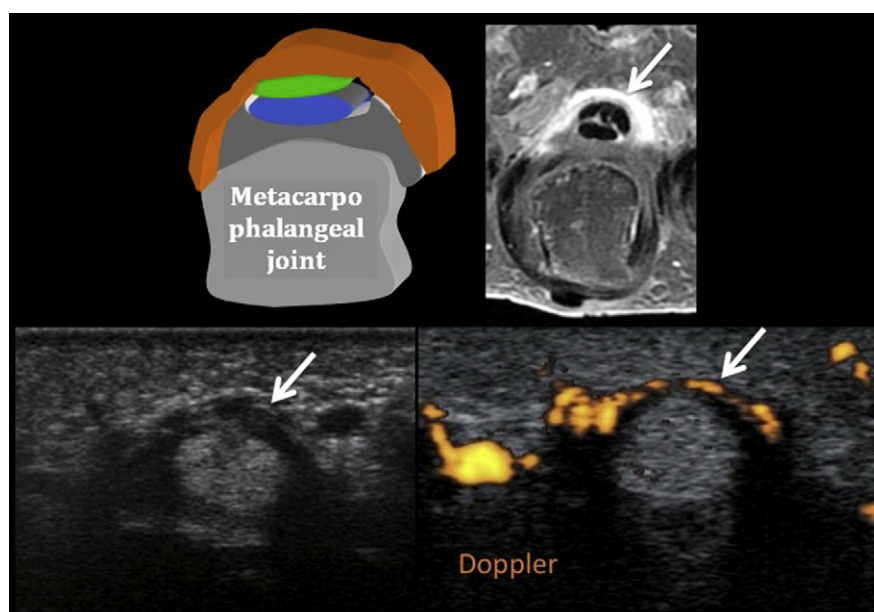


Figure 1. Hypertrophy of the A1 pulley (arrow) at the metacarpophalangeal joint is the hallmark of trigger finger.

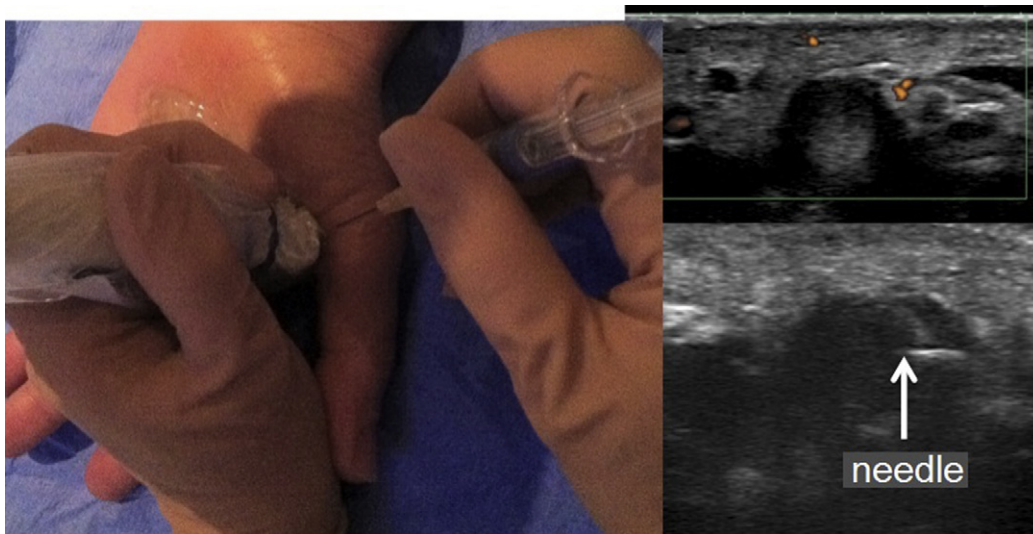


Figure 3. An axial approach, avoiding the neurovascular bundle, can be used to inject a trigger thumb.

Advice and hints

An axial approach, avoiding the neurovascular bundle, may be used for the thumb (Fig. 3). Choose the sagittal approach for the other fingers (Fig. 4).

Post-procedure recommendations

Relative rest is advised for 48 hours, without immobilising the finger.

Pulley ganglia

Pulley ganglia accounts for 70% of finger swellings. They most often occur in women (2.6/1) and are usually on the middle or ring finger. In 69% of cases they occur near the A1 and A2 pulleys. The cystic and non-tissue nature of the

swelling must be confirmed by ultrasonography before the injection. Two ultrasound-guided intracystic injections can be offered before envisaging surgery, the complications of which are an unattractive or annoying scar and damage to the neurovascular pedicle. After percutaneous treatment, they recur in 23 to 35% of cases [5].

Advice and hints

The approach to the cyst is direct, if possible its contents are removed, and then a drop of corticosteroid injected.

Post-procedure recommendations

Relative rest is advised for 48 hours, without immobilising the finger.

Tenosynovitis

All types of tenosynovitis, whether inflammatory or mechanical, may be treated by ultrasound-guided injection (Fig. 5). Suspected acute or chronic infection (purulent inflammation) of the sheaths, such as infection by slow growing microorganisms or mycobacteria, strictly contraindicates this procedure.

Advice and hints

The approach is always sagittal in the axis of the finger and tendon. Depending on the location of the liquid or the thickening of the sheath, the proximal or distal recess of the sheath is approached first.

Check correct peritendinous distribution of the corticosteroid near the injection site and also further away, along the whole of the sheath.

Post-procedure recommendations

Relative rest is advised for 48 hours, possibly with the finger splinted to the adjacent finger.



Figure 4. Sagittal approach to inject a trigger finger or tenosynovitis.

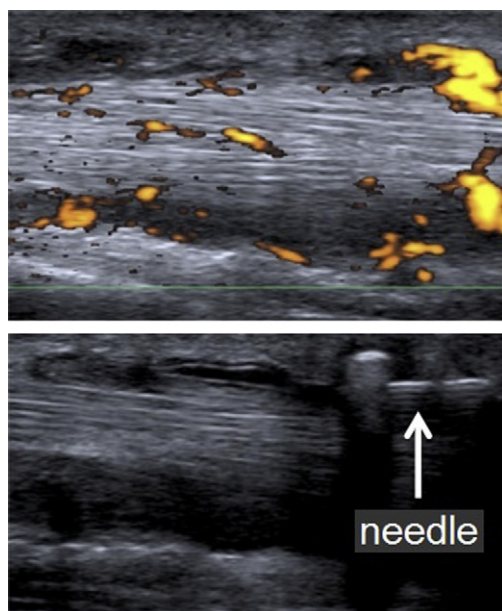


Figure 5. Injection of a flexor tenosynovitis in a rheumatic context.

The wrist

De Quervain's tenosynovitis

De Quervain's tenosynovitis (DQTS) is a mechanical tenosynovitis related to thickening of the retinaculum, which covers the first dorsal compartment of the wrist [6]. A number of factors favour it, including the presence of a septum dividing the first compartment into two subcompartments (Fig. 6) [7]. Two clinical forms of de Quervain's disease can therefore be distinguished [8]:

- type I, tenosynovitis constricting the two tendons without a septum (Fig. 7);

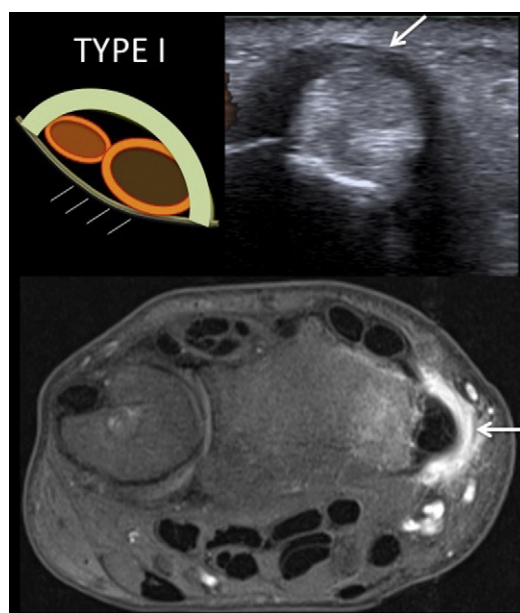


Figure 7. De Quervain type I constrictive tenosynovitis. Thickening of the retinaculum (arrow) over the abductor pollicis longus and extensor pollicis brevis tendons.

- type II, tenosynovitis with isolated constriction of the extensor pollicis brevis tendon, the two tendons being separated by a thin septum (Fig. 8).

It is essential for therapeutic management to be aware of these two forms. The failure rate for unguided injections seems to be approximately 20% and is thought to be due to the presence of this septum [9]. In type I, injection can be simply under the retinaculum into the sheath of the two tendons. In type II, with ultrasound guidance the sheath of the extensor pollicis brevis tendon can be targeted exclusively or the corticosteroid distributed into both subcompartments.

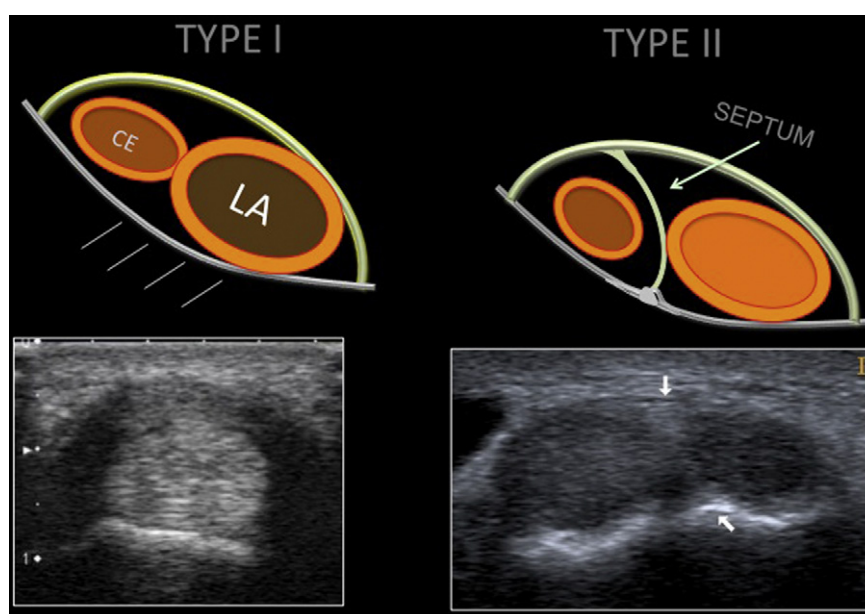


Figure 6. The two types of de Quervain's tendinopathy.

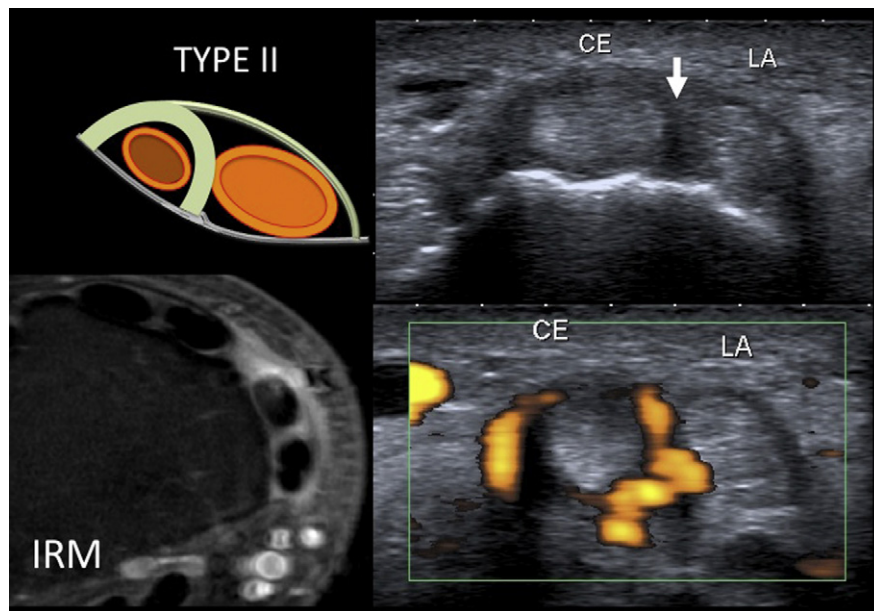


Figure 8. De Quervain type II constrictive tenosynovitis with presence of a septum. The thickening of the retinaculum is localised around the extensor pollicis brevis tendon.

Technique

The patient is installed comfortably in the dorsal decubitus position with his or her wrist resting on a wedge with a slight ulnar inclination (Fig. 9). Two approaches, sagittal or axial, can be used.

Advice and hints

When there is a septum the axial approach is preferable in order to distribute the product into both subcompartments (Fig. 9).

The sensory branch of the radial nerve, which passes superficial to the retinaculum, must be located and avoided, as must the superficial veins.

When the tenosynovitis is very constrictive, injection under the retinaculum is difficult. The sheaths distended by the peritendinous liquid effusion can, in this case, be injected proximal and distal to the retinaculum.

The carpal tunnel

Ultrasound diagnosis of carpal tunnel syndrome (CTS) is based on showing a disparity in the calibre of the nerve,

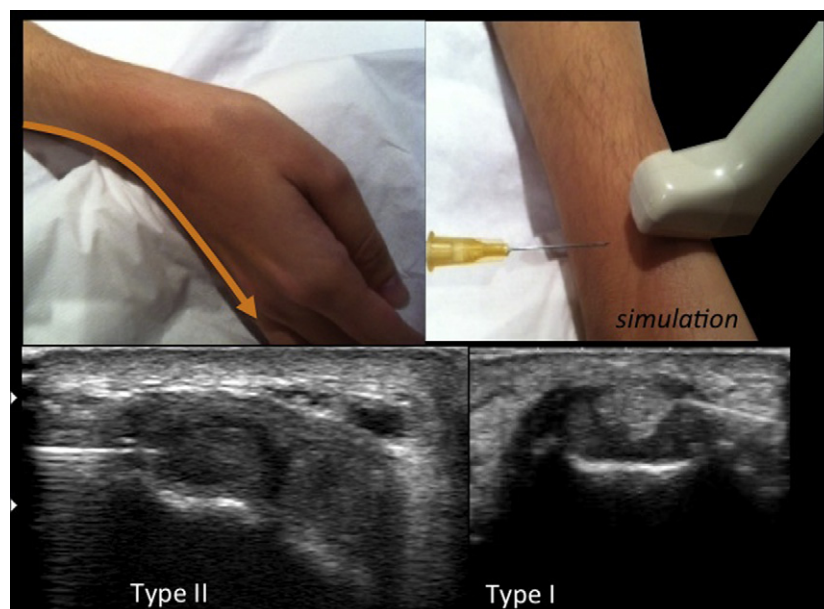


Figure 9. Position of the patient and axial approach for injection of a de Quervain's tenosynovitis. Needle in place in a type II condition in the extensor brevis subcompartment, and under the retinaculum in a type I.

measurement of the surface area of the nerve ($> 12 \text{ mm}^2$), modification to its ultrasonic structure (hypoechoic nerve and hyperaemia with Doppler), the degree of flattening and the bulging of the flexor retinaculum [10]. Ultrasound is also used to look for an aetiology and a local anatomical variant, such as the presence of a persistent median artery (found in 20% of cases). The efficacy of the injections has been shown by comparison with placebo and oral corticosteroid treatment, when the clinical condition is moderate. Sixty percent of patients say they are greatly or very greatly relieved after a single injection and have not undergone surgery after 6 years of follow-up [11,12].

Technique

Place the wrist in slight dorsiflexion. Two axial approaches are possible: the ulnar route is recommended by Smith et al. and consists of distributing the corticosteroid around the nerve ("target sign") [13]; a radial route, avoiding the radial artery and passing under the radiocarpal flexor has also been proposed [14].

Advice and hints

Approach the nerve but keep clear of it!

Post-procedure recommendations

Rest with a wrist splint for 48 hours.

Ganglion cysts

Synovial cysts account for 60% of tumefactions of the wrist and hand. In 95% of cases their characteristic ultrasound appearance is of a sometimes partitioned, anechoic structure, the walls of which appear little vascularised or non-vascularised with Doppler. They communicate with the subjacent joints via a hole, which should be carefully sought with ultrasound. Before envisaging surgical treatment, aspiration and injection can be proposed [15].

Techniques

The approach depends on the location of the cyst. It can be axial or sagittal depending on the size and the anatomical structures to be avoided, in particular the radial and ulnar arteries.

Advice and hints

The contents of the cyst can be thick if the cyst is "old", so that it is best to use a large calibre needle (IM green needle). Lavage of the cyst with xylocaine is sometimes carried out.

Post-procedure recommendations

Rest for the joint with splinting of the wrist is recommended for 48 hours.

The forearm

Intersection syndrome

The point where the myotendinous junction of the dorsal first compartment tendons (adductor pollicislongus and

extensor pollicisbrevis tendons) crosses the second compartment tendons (the extensor carpi radialis tendons) may give rise to intersection syndrome. Ultrasonography confirms simple peritendinous oedema, which is more or less hyperaemic with Doppler, or occasionally true bursitis, at the point, which was painful on palpation.

Distal intersection syndrome

Lower down, the distal intersection is where the tendons of the extensor pollicislongus cross the extensor carpi radialis tendons. Ultrasound detects tenosynovitis in both the tendon sheaths of these two tendon groups.

Technique

The approach to the lower third of the forearm is dorsal and axial, approximately 10 cm above the radial styloid process for intersection syndrome (Fig. 10), or level with the radiocarpal joint for distal intersection syndrome (Fig. 11).

Advice and hints

The needle can be successively and specifically repositioned into each tendon sheath to distribute the corticosteroid (Fig. 11a, b).

Post-procedure recommendations

Rest the joint with a wrist splint for 48 hours.

The elbow

Epicondylitis

Epicondylitis or tennis elbow is due to damage to the common extensor tendon. Ultrasonography confirms the diagnosis by showing thickening of the tendon, changes to its ultrasound structure and its fibre architecture, microcalcifications, enthesophytes and hyperaemia with power Doppler. Intratendinous fissures or partial disinsertion are seen as liquid hypoechoic areas, which are intratendinous, or at the deep surface of the tendon. Cortisone injections have proved effective in the short term but their efficacy is less convincing in the medium or long term [16].

Technique

The patient is installed in the dorsal decubitus position, his or her arm resting on a table at the right height, the elbow flexed at 90° . The approach is longitudinal in the long axis of the tendon. Use a fine needle (orange) parallel to the subcutaneous plane.

Advice and hints

Some practitioners, at the same time, perforate the tendon with the needle in a number of places to encourage bleeding, which improves healing.

Post-treatment recommendations

Rest the tendon, in particular stop sporting activities, for 8 to 10 days.

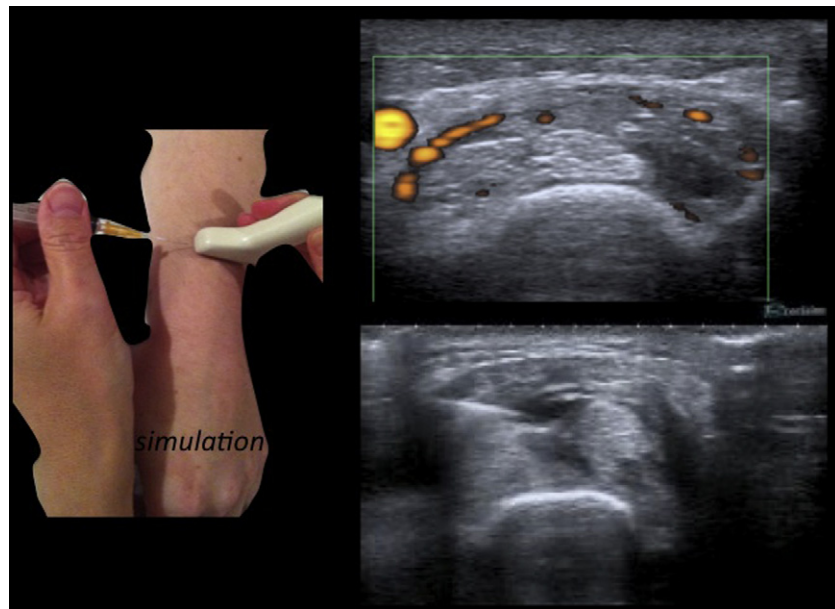


Figure 10. Intersection syndrome.

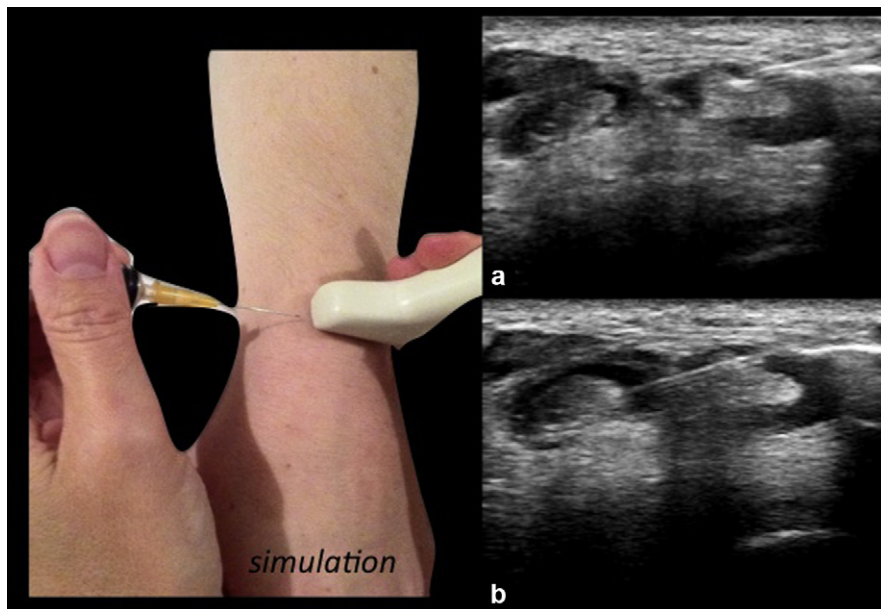


Figure 11. Distal intersection syndrome, approach and needle in place (a) in the sheath of the extensor carpi radialis tendons, (b) in the sheath of the extensor pollicis longus tendon.

Cubital tunnel syndrome

A cortisone injection can be offered for compression of the nerve in the cubital tunnel [17,18].

Technique

The patient is placed in the ventral decubitus position, his arm flexed in internal rotation resting on the bed. The approach to the cubital tunnel is axial. Inject a few drops of corticosteroid, remaining clear of the nerve.

The shoulder

The subacromial bursa

Subacromial conflicts are responsible for inflammation of the subacromial bursa (SAB) and involvement of the superficial side of the rotator cuff. In 15 to 70% of cases, injections relying on clinical landmarks are not into the SAB. X-ray guided injections should be abandoned because of irradiation and because they promote sensitisation to iodinated contrast agents. Ultrasound guidance is simple. Positioning the arm in internal rotation clears the subacromial bursa

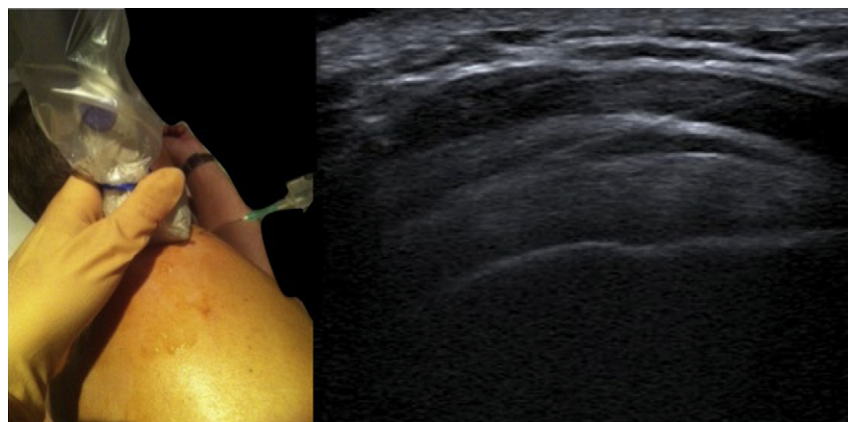


Figure 12. Injection of the subacromial bursa. Needle in place between the two layers of the bursa.

from the acromion. The needle, in the axis of the probe, is monitored throughout its course.

Technique

The patient is installed in the dorsal or lateral decubitus position, his arm in internal rotation, and his hand alongside the thigh or in the small of the back. The approach is anterolateral. The corticosteroid is injected between the two layers of the subacromial bursa (Fig. 12).

Advice and hints

Xylocaine can be injected superficial to the bursa to limit pain felt on passing the needle through the superficial wall of the bursa.

Post-treatment recommendations

Rest the joint for 48 hours, with no sport for a week.

Calcific tendinitis

Ultrasound-guided percutaneous treatment of intratendinous calcifications should now be preferred to radio-guidance. It avoids irradiation, is equivalent or better in terms of clinical results and allows the action of the needle on the calcification to be monitored in real time [19]. Ultrasonography can also predict the consistency of the calcification, depending on its attenuation or non-attenuation characteristics, and therefore the parts within a calcification most favourable for fragmentation can be chosen (Fig. 13).

Techniques

The patient is installed comfortably in the dorsal or lateral decubitus position. The arm is placed in internal rotation to bring the calcification clear of the subacromial space. The approach is anterolateral but must be adapted to the exact location of the calcareous mass.

Advice and hints

There are four stages in the procedure:

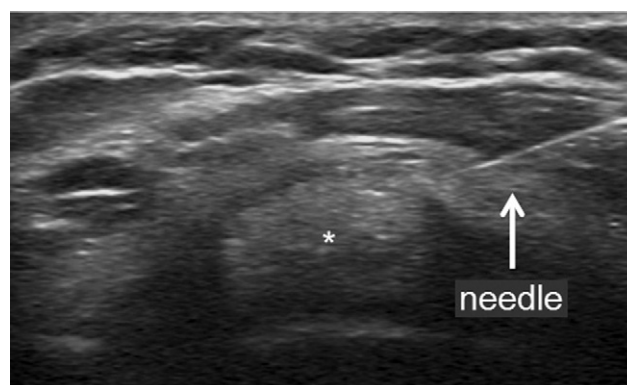


Figure 13. Homogeneous nodular intratendinous calcification (*) with little attenuation and soft in consistency.

- 1) injection of an anaesthetic into the SAB;
- 2) puncture then gradual fragmentation with the needle, constantly monitoring the latter as well as the changes to the calcification;
- 3) injection of a corticosteroid into the SAB;
- 4) providing a warning of the possible increase in pain, prescribing an analgesic and advising the use of an ice-pack on the shoulder.

Acromioclavicular joint

The often forgotten acromioclavicular joint can by itself be responsible for periarticular shoulder pain. It should be investigated as part of the systematic examination of a painful shoulder, looking for synovitis around the joint space.

Technique

The patient is installed in the dorsal decubitus position. The probe is placed over the joint space. The approach is anteroposterior and direct (Fig. 14).

Advice and hints

Visible distension of the articular cavity confirms that the injection was intra-articular.

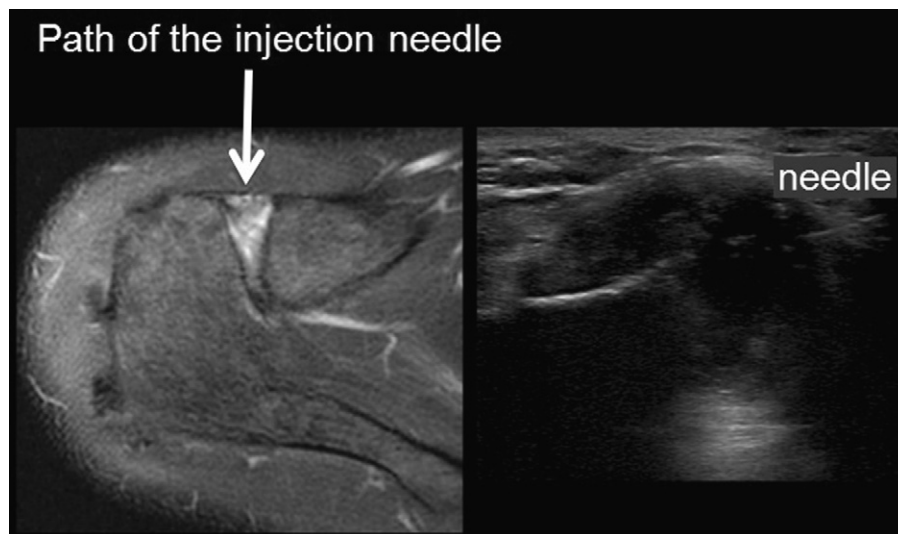


Figure 14. Injection of the acromioclavicular joint via the direct anterior-posterior route.

Disclosure of interest

The authors declare that they have no conflicts of interest concerning this article.

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